Geophysical Research Abstracts
Vol. 17, EGU2015-983, 2015
EGU General Assembly 2015
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Modelling transport of storm-water pollutants using the distributed Multi-Hydro platform on an urban catchment near Paris

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Nowadays, the increasingly use of vehicles causes expanding contaminated storm-water runoff from roads and the associated quarters. Besides, the current utilization of city's separated sewer systems underlines the needs for evaluating precisely the growing impact of these polluted effluents on receiving water bodies. Nevertheless, traditional means of water quality modelling had shown its limits (Kanso, 2004), more accurate modelling schemes are hence required. In this paper, we found that the application of physically based and fully distributed model coupled with detailed high-resolution data is a promising approach to reproduce the various dynamics and interactions of water quantity/quality processes in urban or peri-urban environment.
Over recent years, the physically based and spatially distributed numerical platform Multi-Hydro (MH) has been developed at Ecole des Ponts ParisTech (El-Tabach et al. , 2009 ; Gires et al., 2013 ; Giangola-Murzyn et al., 2014). This platform is particularly adapted for representing the hydrological processes for medium size watersheds, including the surface runoff, drainage water routing and the infiltrations on permeable zones. It is formed by the interactive coupling of several independent modules, which depend on generally used open-access models. In the framework of the ANR (French National Agency for Research) Trafipollu project, a new extension of MH, MH-quality, was set up for the water-quality modelling.
MH-quality was used for the simulation of pollutant transport on a peri-urban and highly trafficked catchment located near Paris (Le Perreux-sur-Marne, 0.2 km2). The set-up of this model is based on the detailed description of urban land use features. For this purpose, 15 classes of urban land uses relevant to water quality modelling were defined in collaboration with the National Institute of Geography of France (IGN) using Digital Orthophoto Quadrangles (5cm). The delimitation of the urban catchment was then performed by operating a Digital Terrain Model which was generated by applying Lidar data (20cm), and by using GIS information of the drainage system. In addition to land use information, the implementation of different human activities allows a better evaluation of contamination. Experimental data such as rainfall intensities, particle size distribution and dry weather depositions are also used, in order to feed the model with realistic input data and parameters. The runoff and water quality are then simulated for a few rainfall events. Taking advantage of the available data of the continuous observations of precipitation, water discharges and turbidity at the outlet of the drainage systems, the sensitivity analysis is carried out in order to evaluate the performance of MH-quality and the most sensitive parameters. Using appropriate parameters, we are now able to follow the pollutant transport on our experimental urban catchment. The limitations and the perspectives of MH-quality are discussed as well.